WHAT IS CLAIMED IS:

1. A field-effect transistor comprising:

a Group III nitride semiconductor layer structure which includes a heterojunction;

a source electrode and a drain electrode which are formed on the semiconductor layer structure while being separated from each other; and

a gate electrode which is arranged between said source electrode and said drain electrode,

wherein, an electric-field control electrode is formed through an insulating film in an upper portion of said Group III nitride semiconductor layer structure, said electric-field control electrode being located in an area between said gate electrode and said drain electrode, and

said insulating film is a multilayered film including a first insulating film and a second insulating film, said first insulating film containing silicon and nitrogen as constituent elements, said second insulating film having a dielectric constant lower than that of said first insulating film.

2. A field-effect transistor according to claim 1, wherein, said first insulating film is formed while being in contact with a surface of said Group III nitride semiconductor layer structure, and said second insulating film is laminated on said first insulating film.

3. A field-effect transistor according to claim 1 or 2, wherein, said first insulating film is not more than 150 nm.

4. A field-effect transistor according to any one of claims 1 to 3, wherein, a dielectric constant of said second insulating film is not more than 3.5.

5. A field-effect transistor according to any one of claims 1 to 4, wherein, further comprising a third insulating film which contains silicon and nitrogen as constituent elements, said third insulating film being provided on said second insulating film.

6. A field-effect transistor according to any one of claims 1 to 5, wherein, said insulating film including the multilayered film is formed while being separated from said gate electrode, the multilayered film having said first insulating film and said second insulating film, and said second insulating film is provided between said insulating film and said gate electrode.

7. A field-effect transistor comprising:

a Group III nitride semiconductor layer structure which includes a heterojunction;

a source electrode and a drain electrode which are formed

on the semiconductor layer structure while being separated from each other; and

a gate electrode which is arranged between said source electrode and said drain electrode,

wherein, an electric-field control electrode is formed through an insulating film in an upper portion of said Group III nitride semiconductor layer structure, said electric-field control electrode being located in an area between said gate electrode and said drain electrode, and

said insulating film contains silicon and nitrogen as constituent elements.

8. A field-effect transistor comprising:

a Group III nitride semiconductor layer structure which includes a heterojunction;

a source electrode and a drain electrode which are formed on the semiconductor layer structure while being separated from each other; and

a gate electrode which is arranged between said source electrode and said drain electrode,

wherein, an electric-field control electrode is formed through an insulating film in an upper portion of said Group III nitride semiconductor layer structure, said electric-field control electrode being located in an area between said gate electrode and said drain electrode, and

said insulating film is an insulating film which contains silicon, oxygen, and carbon as constituent elements.

9. A field-effect transistor according to claim 7, wherein, said insulating film further contains oxygen and/or carbon as a constituent element.

10. A field-effect transistor comprising:

a Group III nitride semiconductor layer structure which includes a heterojunction;

a source electrode and a drain electrode which are formed on the semiconductor layer structure while being separated from each other; and

a gate electrode which is arranged between said source electrode and said drain electrode,

wherein, an electric-field control electrode is formed through an insulating film in an upper portion of said Group III nitride semiconductor layer structure, said electric-field control electrode being located in an area between said gate electrode and said drain electrode,

said insulating film on said gate electrode side is formed by an insulating material which does not contain nitrogen as a constituent element, and

said insulating film on said drain electrode side is formed by an insulating material which contains silicon and nitrogen as constituent elements.

11. A field-effect transistor according to claim 10, wherein, the insulating material provided on said drain

electrode side, of said insulating film further contains oxygen and/or carbon as a constituent element in addition to silicon and nitrogen.

12. A field-effect transistor comprising:

a Group III nitride semiconductor layer structure which includes a heterojunction;

a source electrode and a drain electrode which are formed on the semiconductor layer structure while being separated from each other; and

a gate electrode which is arranged between said source electrode and said drain electrode,

wherein, an electric-field control electrode is formed through an insulating film in an upper portion of said Group III nitride semiconductor layer structure, said electric-field control electrode being located in an area between said gate electrode and said drain electrode, and

a dielectric constant of said insulating film is not more than 3.5.

13. A field-effect transistor according to any one of claims 1 to 12, wherein, said Group III nitride semiconductor layer structure includes a channel layer made of $In_xGa_{1-x}N$ ($0 \leq x \leq 1$) and an electron supply layer made of $Al_yGa_{1-y}N$ ($0 < y \leq 1$).

14. A field-effect transistor according to any one of claims

1 to 13, wherein, contact layers are arranged between said source electrode and a surface of said Group III nitride semiconductor layer structure and between said drain electrode and a surface of said Group III nitride semiconductor layer structure, respectively.

15. A field-effect transistor according to claim 14, wherein, said contact layer is formed by an undoped AlGaN layer.

16. A field-effect transistor according to claim 14 or 15, wherein, said electric-field control electrode extends to an upper portion of said contact layer.

17. A field-effect transistor according to any one of claims 1 to 16, wherein, said Group III nitride semiconductor layer structure has a structure in which the channel layer made of $In_xGa_{1-x}N$ ($0 \leq x \leq 1$), the electron supply layer made of $Al_yGa_{1-y}N$ ($0 < y \leq 1$), and a cap layer made of GaN are sequentially laminated.

18. A field-effect transistor according to any one of claims 1 to 17, wherein, said electric-field control electrode can be controlled independently of said gate electrode.